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BERLIN RESERVOIR, MAHONING, PORTAGE, AND STARK COUNTIES, OHIO

PACIFIC NORTHWEST ENVIRONMENTAL RESEARCH LABORATORY

PREPARED FOR
NATIONAL ENVIRONMENTAL RESEARCH CENTER

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16. ABSTRACT

Annual total phosphorus and total nitrogen loadings to the lake were estimated and subdivided according to either point or non-point source origin. An assessment of the lake's trophic condition and limiting nutrient is also provided. All data collected by the U.S.E.P.A. National Eutrophication Survey during the one year study of the lake and its tributaries are included in the report.

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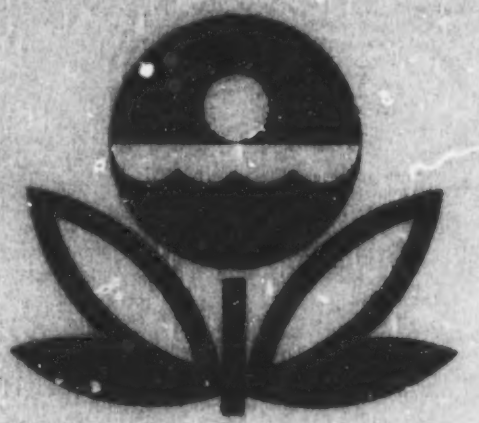

REPORT

ON

BERLIN RESERVOIR

MAHONING, PORTAGE, AND STARK COUNTIES

OHIO

EPA REGION V

WORKING PAPER No. 395

PACIFIC NORTHWEST ENVIRONMENTAL RESEARCH LABORATORY

An Associate Laboratory of the

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WITH THE COOPERATION OF THE

OHIO ENVIRONMENTAL PROTECTION AGENCY

AND THE

OHIO NATIONAL GUARD

JUNE, 1975

CONTENTS

	Page
Foreword	ii
List of Ohio Study Lakes	iv
Lake and Drainage Area Map	v
Sections	
I. Conclusions	1
II. Lake and Drainage Basin Characteristics	3
III. Lake Water Quality Summary	4
IV. Nutrient Loadings	9
V. Literature Reviewed	14
VI. Appendices	15

FOREWORD

The National Eutrophication Survey was initiated in 1972 in response to an Administration commitment to investigate the nationwide threat of accelerated eutrophication to fresh water lakes and reservoirs.

OBJECTIVES

The Survey was designed to develop, in conjunction with state environmental agencies, information on nutrient sources, concentrations, and impact on selected freshwater lakes as a basis for formulating comprehensive and coordinated national, regional, and state management practices relating to point-source discharge reduction and non-point source pollution abatement in lake watersheds.

ANALYTIC APPROACH

The mathematical and statistical procedures selected for the Survey's eutrophication analysis are based on related concepts that:

a. A generalized representation or model relating sources, concentrations, and impacts can be constructed.

b. By applying measurements of relevant parameters associated with lake degradation, the generalized model can be transformed into an operational representation of a lake, its drainage basin, and related nutrients.

c. With such a transformation, an assessment of the potential for eutrophication control can be made.

LAKE ANALYSIS

In this report, the first stage of evaluation of lake and watershed data collected from the study lake and its drainage basin is documented. The report is formatted to provide state environmental agencies with specific information for basin planning [§303(e)], water quality criteria/standards review [§303(c)], clean lakes [§314(a,b)], and water quality monitoring [§106 and §305(b)] activities mandated by the Federal Water Pollution Control Act Amendments of 1972.

Beyond the single lake analysis, broader based correlations between nutrient concentrations (and loading) and trophic condition are being made to advance the rationale and data base for refinement of nutrient water quality criteria for the Nation's fresh water lakes. Likewise, multivariate evaluations for the relationships between land use, nutrient export, and trophic condition, by lake class or use, are being developed to assist in the formulation of planning guidelines and policies by EPA and to augment plans implementation by the states.

ACKNOWLEDGMENT

The staff of the National Eutrophication Survey (Office of Research & Development, U. S. Environmental Protection Agency) expresses sincere appreciation to the Ohio Environmental Protection Agency for professional involvement, to the Ohio National Guard for conducting the tributary sampling phase of the Survey, and to those Ohio wastewater treatment plant operators who provided effluent samples and flow data.

Ned Williams, Director, and Tom Birch, Ken Carr, Larry Dietrick, Ron Havlice, Larry Korecko, Rod Mehlhop, Terry Wheeler, and John Youger, Ohio Environmental Protection Agency, provided invaluable lake documentation and counsel during the Survey, reviewed the preliminary reports, and provided critiques most useful in the preparation of this Working Paper series.

Major General Dana L. Stewart, then the Adjutant General of Ohio, and Project Officer Lt. Colonel Robert C. Timmons, who directed the volunteer efforts of the Ohio National Guardsmen, are also gratefully acknowledged for their assistance to the Survey.

NATIONAL EUTROPHICATION SURVEY

STUDY LAKES

STATE OF OHIO

LAKE NAME	COUNTY
Atwood	Carroll, Tuscarawas
Beach City	Stark, Tuscarawas
Berlin	Mahoning, Portage, Stark
Buckeye	Fairfield, Licking, Perry
Charles Mill	Ashland, Richland
Deer Creek	Fayette, Pickaway
Delaware	Delaware
Dillon	Muskingum
Grand Lake of St. Marys	Auglaize, Mercer
Grant	Brown
Holiday	Huron
Hoover	Delaware, Franklin
Indian	Logan
Loramie	Auglaize, Shelby
Mosquito Creek	Trumbull
O'Shaughnessy	Delaware
Pymatuning	Ashtabula, OH; Crawford, PA
Pleasant Hill	Ashland, Richland
Rocky Fork	Highland
Shawnee	Greene
Tappan	Harrison

Ohio
Map Location
Lake Milton
A1
dam outlet
01
Willow Creek
F1
Deerfield
02
Turkey Broth Cr.
Berlin Center
05
03
04
B1
41°00'
Deer Creek
Deer Creek Reservoir
E1
06
07
BERLIN RESERVOIR
C1
Island Creek
Mills Cr.
Potmas
Little Beech Creek
Beech Cr.
D1
A2
Alliance
Sebring
Garfield
Damascus
Westville
Westville Lake
Mahoning River
Placentid Lake
North Georgetown
40°50'
BERLIN RESERVOIR
Tributary Sampling Site
Lake Sampling Site
Sewage Treatment Facility
Drainage Area Boundary
0 2 4 6 8 Km.
0 2 4 Mi.
Scale
81°10'
81°00'

BERLIN RESERVOIR

STORET NO. 3929

I. CONCLUSIONS

A. Trophic Condition:

Survey data indicate that Berlin Reservoir is eutrophic. It ranked fourth in overall trophic quality when the 20 Ohio lakes sampled in 1973 were compared using a combination of six parameters*. Four lakes had less median total phosphorus, one had less and one had the same median dissolved phosphorus, 11 had less median inorganic nitrogen, five had less mean chlorophyll a, and five had greater mean Secchi disc transparency.

Survey limnologists did not observe surface algal accumulations or macrophytes; however, chlorophyll a concentrations were consistently high at the various sampling sites.

B. Rate-Limiting Nutrient:

The algal assay results indicate that Berlin Reservoir was phosphorus limited at the time the assay samples were taken (04/24/73). These results were substantiated by the lake data; i.e., the mean inorganic nitrogen to orthophosphorus ratios were 47 to 1 or greater at all sampling times.

C. Nutrient Controllability:

1. Point sources--The phosphorus contribution of known municipal point sources accounted for 66.9% of the total load reaching Berlin Reservoir during the Survey sampling year. The wastewater

* See Appendix A.

treatment plants at Alliance and Sebring contributed 56.2% and 10.8% of the total, respectively.

The phosphorus loading of 5.87 $g/m^2/yr$ is over six times that proposed by Vollenweider (Vollenweider and Dillon, 1974) as a eutrophic loading (see page 13). For this reason, all phosphorus inputs should be minimized to the greatest practicable extent. A 100% reduction of phosphorus from the municipal point sources would lower the loading to 1.94 $g/m^2/yr$. If attainable, this degree of reduction should at least slow the rate of eutrophication of the reservoir. The relatively short hydraulic retention time of 81 days would facilitate improvement of water quality after phosphorus controls are initiated.

2. Non-point sources--During the sampling year, the phosphorus contribution of non-point sources, excluding precipitation, accounted for 32.4% of the total load to the lake. The Mahoning River contributed 14.4%, Beech Creek contributed 2.6% the Deer Creek Reservoir outlet contributed 2.5%, and the remaining three tributaries collectively contributed 3.6% of the total load. Ungaged tributaries were estimated to have contributed 9.3% of the total.

The phosphorus export rate of Island Creek was appreciably higher than the rates of the other Berlin Reservoir tributaries (see page 13). However, there are no known point sources impacting Island Creek, and the higher export rate may be the result of differing land-use practices.

II. LAKE AND DRAINAGE BASIN CHARACTERISTICS†

A. Lake Morphometry††:

1. Surface area: 8.90 kilometers^2.
2. Mean depth: 4.9 meters.
3. Maximum depth: >14.0 meters.
4. Volume: 43.610 x 10^6 m^3.
5. Mean hydraulic retention time: 81 days (based on outlet flow).

B. Tributary and Outlet:
(See Appendix C for flow data)

1. Tributaries -

Name	Drainage area (km^2)*	Mean flow (m^3/sec)*
Mahoning River	231.0	2.2
Mills Creek	49.5	0.5
Island Creek	15.3	0.2
Beech Creek	49.2	0.5
Deer Creek Res. outlet	98.4	1.0
Willow Creek	16.8	0.2
Minor tributaries & immediate drainage -	173.2	1.8
Totals	633.4	6.4

2. Outlet -

Mahoning River	642.3**	6.2

C. Precipitation***:

1. Year of sampling: 96.4 centimeters.
2. Mean annual: 91.3 centimeters.

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† Table of metric equivalents--Appendix B.
†† Youger, 1975.
* For limits of accuracy, see Working Paper No. 175, "...Survey Methods, 1973-1976".
** Includes area of lake.
*** See Working Paper No. 175.

III. LAKE WATER QUALITY SUMMARY

Berlin Reservoir was sampled three times during the open-water season of 1973 by means of a pontoon-equipped Huey helicopter. Samples for physical and chemical parameters were collected from a number of depths at seven lake stations in the spring, four stations in the summer, and five stations in the fall (see map, page v). During each visit, a single depth-integrated (4.6 m or near bottom to surface) sample was composited from the sampled stations for phytoplankton identification and enumeration; and during the first visit, two 18.9-liter depth-integrated samples were composited for algal assays (stations 1, 2, 3, and 4 were combined, and stations 5, 6, and 7 were combined). Also each time, a depth-integrated sample was collected from each of the stations for chlorophyll a analysis. The maximum depths sampled were 7.6 meters at station 1, 14.0 meters at station 2, 7.6 meters at station 3, 4.6 meters at station 4, 8.8 meters at station 5, 3.0 meters at station 6, and 1.5 meters at station 7.

The sampling results are presented in full in Appendix D and are summarized in the following table. During the April sampling visit, replicate samples were taken for quality control purposes. For comparison of these results and differences in the various parameters at the other sampling times, refer to Appendix D.

A. SUMMARY OF PHYSICAL AND CHEMICAL CHARACTERISTICS FOR BERLIN RESERVOIR
STORET CODE 3929

PARAMETER	1ST SAMPLING (4/24/73) 7 SITES RANGE	MEAN	MEDIAN	2ND SAMPLING (7/30/73) 4 SITES RANGE	MEAN	MEDIAN	3RD SAMPLING (10/ 8/73) 5 SITES RANGE	MEAN	MEDIAN
TEMP (C)	10.0 - 17.2	13.5	13.3	23.6 - 24.8	24.4	24.4	18.4 - 19.7	18.9	18.8
DISS OXY (MG/L)	6.4 - 11.8	9.6	9.7	1.4 - 7.3	5.3	5.5	3.8 - 9.8	6.1	5.8
CNDCTVY (MCROMO)	360. - 440.	390.	385.	396. - 534.	434.	413.	402. - 574.	431.	422.
PH (STAND UNITS)	7.1 - 8.5	7.9	7.9	7.2 - 9.3	7.9	7.7	7.5 - 8.2	7.7	7.6
TOT ALK (MG/L)	27. - 82.	62.	61.	76. - 120.	86.	80.	80. - 113.	89.	88.
TOT P (MG/L)	0.024 - 0.238	0.066	0.042	0.026 - 0.221	0.056	0.033	0.038 - 0.126	0.059	0.048
ORTHO P (MG/L)	0.003 - 0.070	0.019	0.006	0.002 - 0.034	0.007	0.003	0.005 - 0.011	0.007	0.007
NO2+NO3 (MG/L)	0.590 - 1.100	0.888	0.890	0.140 - 0.890	0.306	0.235	0.200 - 0.320	0.256	0.260
AMMONIA (MG/L)	0.030 - 0.220	0.087	0.070	0.080 - 0.600	0.186	0.130	0.040 - 0.280	0.072	0.050
KJEL N (MG/L)	0.500 - 1.200	0.769	0.700	0.500 - 1.600	0.893	0.800	0.400 - 2.300	0.823	0.700
INORG N (MG/L)	0.630 - 1.170	0.974	0.975	0.320 - 1.490	0.492	0.365	0.270 - 0.560	0.328	0.300
TOTAL N (MG/L)	1.320 - 2.130	1.657	1.615	0.780 - 2.490	1.199	1.060	0.660 - 2.580	1.079	0.960
CHLRPYL A (UG/L)	10.1 - 22.8	16.3	14.7	5.4 - 15.7	11.5	12.4	6.0 - 52.5	16.5	7.8
SECCHI (METERS)	0.6 - 1.3	0.9	0.9	0.5 - 1.0	0.8	0.9	0.5 - 1.0	0.8	0.9

B. Biological characteristics:

1. Phytoplankton -

Sampling Date	Dominant Genera	Algal Units per ml
04/24/73	1. Melosira sp.	1,768
	2. Flagellates	1,681
	3. Cryptomonas sp.	1,092
	4. Nitzschia sp.	445
	5. Synedra sp.	273
	Other genera	1,034
	Total	6,293
07/30/73	1. Centric diatoms	1,169
	2. Flagellates	627
	3. Melosira sp.	576
	4. Pennate diatoms	322
	5. Cryptomonas sp.	237
	Other genera	1,236
	Total	4,167
10/08/73	1. Flagellates	6,627
	2. Merismopedia sp.	776
	3. Raphidiopsis sp.	692
	4. Scenedesmus sp.	407
	5. Cryptomonas sp.	325
	Other genera	2,519
	Total	11,346

2. Chlorophyll a -

Sampling Date	Station Number	Chlorophyll a (µg/l)
04/24/73	01	13.3
	02	14.7
	03	10.1
	04	22.8
	05	14.3
	06	17.0
	07	22.0

Sampling Date	Station Number	Chlorophyll a (µg/l)
07/30/73	01	5.4
	02	12.2
	03	-
	04	-
	05	12.7
	06	15.7
10/08/73	01	6.3
	02	6.0
	03	7.8
	04	10.1
	05	52.5

C. Limiting Nutrient Study:

1. Autoclaved, filtered, and nutrient spiked -

a. Stations 1, 2, 3, and 4 -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.016	1.004	2.7
0.050 P	0.066	1.004	16.7
0.050 P + 1.0 N	0.066	2.004	20.4
1.0 N	0.016	2.004	2.8

b. Stations 5, 6, and 7 -

Spike (mg/l)	Ortho P Conc. (mg/l)	Inorganic N Conc. (mg/l)	Maximum yield (mg/l-dry wt.)
Control	0.052	0.984	15.0
0.050 P	0.102	0.984	20.3
0.050 P + 1.0 N	0.102	1.984	27.8
1.0 N	0.052	1.984	17.6

2. Discussion -

The control yields of the assay alga, Selenastrum capricornutum, indicate that the potential primary productivity of Berlin Reservoir at stations 1, 2, 3, and 4 (composited) was moderate but was quite high at stations 5, 6, and 7 (composited) at the time of sample collection (04/24/73). The

control yield of the stations 5-7 sample was over five times the control yield of the stations 1-4 sample. The high phosphorus levels and high control yield from stations 5-7 are indicative of the proximity of nutrient point sources upstream of these stations.

The algal assay results also indicate that Berlin Reservoir was phosphorus limited at the time the samples were collected. Note the lack of a significant increase in the yields when nitrogen alone was added; but with the addition of phosphorus alone, the yields increased significantly.

The lake data also indicate phosphorus limitation for the reservoir at the time of sample collection (April, 1973) as well as the July and October, 1973, samplings. The mean inorganic nitrogen to orthophosphorus ratios were 47 to 1 or greater at all sampling times, and phosphorus limitation would be expected.

IV. NUTRIENT LOADINGS
(See Appendix E for data)

For the determination of nutrient loadings, the Ohio National Guard collected monthly near-surface grab samples from each of the tributary sites indicated on the map (page v), except for the high runoff months of February and March when two samples were collected. Sampling was begun in May, 1973, and was completed in April, 1974.

Through an interagency agreement, stream flow estimates for the year of sampling and a "normalized" or average year were provided by the Ohio District Office of the U.S. Geological Survey for the tributary sites nearest the lake.

In this report, nutrient loads for sampled tributaries were determined by using a modification of a U.S. Geological Survey computer program for calculating stream loadings*. Nutrient loads shown are those measured minus point-source loads, if any.

Nutrient loads for unsampled "minor tributaries and immediate drainage" ("ZZ" of U.S.G.S.) were estimated using the means of the nutrient loads, in $kg/km^2/year$, at stations B-1, C-1, D-1, and F-1 and multiplying the means by the ZZ area in km^2.

The operator of the Alliance wastewater treatment plant provided monthly effluent samples and corresponding flow data. However, the community of Sebring did not participate in the Survey, and nutrient loads were estimated at 1.134 kg P and 3.401 kg N/capita/year.

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* See Working Paper No. 175.

A. Waste Sources:

1. Known municipal -

Name	Pop. Served	Treatment	Mean Flow (m^3/d)	Receiving Water
Alliance*	30,000	trickling filter	11,705.6	Mahoning River
Sebring**	4,954	trickling filter	1,875.1	Sebring Branch of Mahoning R.

2. Known industrial - None

* Graybill, 1973; more than 25% of the total load to this plant is contributed by industry.
** Anonymous, 1971 (population shown is 1970 Census; flow shown is estimated at 0.3785 m^3/capita/day).

B. Annual Total Phosphorus Loading - Average Year:

1. Inputs -

Source	kg P/ yr	% of total
a. Tributaries (non-point load) -		
Mahoning River	7,530	14.4
Mills Creek	840	1.6
Island Creek	815	1.6
Beech Creek	1,375	2.6
Deer Creek Res. outlet	1,295	2.5
Willow Creek	235	0.4
b. Minor tributaries & immediate drainage (non-point load) -	4,850	9.3
c. Known municipal STP's -		
Alliance	29,370	56.2
Sebring	5,620	10.8
d. Septic tanks* -	180	0.3
e. Known industrial - None	-	-
f. Direct precipitation** -	155	0.3
Total	52,265	100.0

2. Outputs -

Lake outlet - Mahoning River 12,595

3. Net annual P accumulation - 39,670 kg.

* Estimate based on 624 lakeshore dwellings and one park; see Working Paper No. 175.
** See Working Paper No. 175.

C. Annual Total Nitrogen Loading - Average Year:

1. Inputs -

Source	kg N/ yr	% of total
a. Tributaries (non-point load) -		
Mahoning River	155,770	29.3
Mills Creek	41,730	7.9
Island Creek	14,035	2.6
Beech Creek	35,620	6.7
Deer Creek Res. outlet	53,835	10.1
Willow Creek	6,420	1.2
b. Minor tributaries & immediate drainage (non-point load) -	124,010	23.3
c. Known municipal STP's -		
Alliance	67,020	12.6
Sebring	16,850	3.2
d. Septic tanks* -	6,685	1.3
e. Known industrial - None	-	-
f. Direct precipitation** -	9,610	1.8
Total	531,585	100.0

2. Outputs -

Lake outlet - Mahoning River 394,940

3. Net annual N accumulation - 136,645 kg.

* Estimate based on 624 lakeshore dwellings and one park; see Working Paper No. 175.
** See Working Paper No. 175.

D. Mean Annual Non-point Nutrient Export by Subdrainage Area:

Tributary	kg P/km²/yr	kg N/km²/yr
Mahoning River	33	674
Mills Creek	17	843
Island Creek	53	917
Beech Creek	28	724
Deer Creek Res. outlet	13	547
Willow Creek	14	382

E. Yearly Loadings:

In the following table, the existing phosphorus loadings are compared to those proposed by Vollenweider (Vollenweider and Dillon, 1974). Essentially, his "dangerous" loading is one at which the receiving water would become eutrophic or remain eutrophic; his "permissible" loading is that which would result in the receiving water remaining oligotrophic or becoming oligotrophic if morphometry permitted. A mesotrophic loading would be considered one between "dangerous" and "permissible".

Note that Vollenweider's model may not be applicable to water bodies with short hydraulic retention times.

	Total Phosphorus		Total Nitrogen	
	Total	Accumulated	Total	Accumulated
grams/m²/yr	5.87	4.46	59.7	15.4

Vollenweider phosphorus loadings (g/m²/yr) based on mean depth and mean hydraulic retention time of Berlin Reservoir:

"Dangerous" (eutrophic loading)	0.90
"Permissible" (oligotrophic loading)	0.45

V. LITERATURE REVIEWED

Anonymous, 1971. Inventory of municipal waste facilities. EPA Publ. OWP-1, vol. 5, Wash., DC.

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Youger, John, 1975. Personal communication (lake morphometry). OH Env. Prot. Agency, Columbus.

VI. APPENDICES

APPENDIX A

LAKE RANKINGS

LAKES RANKED BY INDEX NOS.

RANK	LAKE CODE	LAKE NAME	INDEX NO
1	3924	ATWOOD RESERVOIR	491
2	3921	MOSQUITO CREEK RESERVOIR	483
3	3924	PLEASANT HILL LAKE	431
4	3929	BERLIN RESERVOIR	429
5	3914	HOOVER RESERVOIR	392
6	3934	TAPPAN LAKE	381
7	3927	LAKE SAINT MARYS	297
8	3932	ROCKY FORK LAKE	292
9	3906	DEER CREEK RESERVOIR	290
10	3901	BEACH CITY RESERVOIR	277
11	3915	INDIAN LAKE	266
12	3907	DELAWARE RESERVOIR	263
13	3912	GRANT LAKE	261
14	3933	SHAWNEE LAKE	249
15	3930	HOLIDAY LAKE	220
16	3905	CHARLES MILL RESERVOIR	216
17	3902	BUCKEYE LAKE	207
18	3908	DILLON RESERVOIR	206
19	3917	LORAMIE LAKE	178
20	3931	O'SHAUGNESSY RESERVOIR	173

PERCENT OF LAKES WITH HIGHER VALUES (NUMBER OF LAKES WITH HIGHER VALUES)

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P	INDEX NO
3901	BEACH CITY RESERVOIR	37 (7)	21 (4)	11 (2)	84 (16)	82 (15)	42 (8)	277
3902	BUCKEYE LAKE	11 (2)	76 (14)	5 (1)	0 (0)	89 (17)	26 (5)	207
3905	CHARLES MILL RESERVOIR	26 (5)	63 (12)	37 (7)	21 (4)	11 (0)	58 (11)	216
3906	DEER CREEK RESERVOIR	53 (10)	5 (1)	63 (12)	95 (18)	63 (12)	11 (2)	290
3907	DELAWARE RESERVOIR	58 (11)	16 (3)	32 (6)	89 (17)	47 (9)	21 (4)	263
3908	DILLION RESERVOIR	16 (3)	32 (6)	42 (8)	58 (11)	53 (10)	5 (1)	206
3912	GRANT LAKE	47 (9)	58 (11)	16 (3)	32 (6)	74 (14)	34 (6)	261
3914	HOOVER RESERVOIR	87 (16)	26 (5)	89 (17)	79 (15)	32 (6)	79 (15)	392
3915	INDIAN LAKE	42 (8)	76 (14)	21 (4)	16 (3)	58 (11)	53 (10)	266
3917	LORAMIE LAKE	5 (1)	37 (7)	0 (0)	5 (1)	97 (18)	34 (6)	178
3921	MOSQUITO CREEK RESERVOIR	74 (14)	100 (19)	82 (15)	53 (10)	82 (15)	92 (17)	483
3924	PLEASANT HILL LAKE	95 (18)	68 (13)	100 (19)	63 (12)	39 (7)	66 (12)	431
3927	LAKE SAINT MARYS	21 (4)	95 (18)	26 (5)	11 (2)	97 (18)	47 (9)	297
3928	ATWOOD RESERVOIR	100 (19)	89 (17)	95 (18)	68 (13)	39 (7)	100 (19)	491
3929	BERLIN RESERVOIR	79 (15)	42 (8)	74 (14)	74 (14)	68 (13)	92 (17)	429
3930	HOLIDAY LAKE	32 (6)	53 (10)	82 (15)	26 (5)	11 (0)	16 (3)	220
3931	O'SHAUGNESSY RESERVOIR	0 (0)	0 (0)	47 (9)	100 (19)	26 (5)	0 (0)	173
3932	ROCKY FORK LAKE	68 (13)	47 (9)	58 (11)	42 (8)	11 (0)	66 (12)	292
3933	SHAWNEE LAKE	63 (12)	11 (2)	53 (10)	37 (7)	11 (0)	74 (14)	249
3934	TAPPAN LAKE	87 (16)	84 (16)	68 (13)	47 (9)	11 (0)	84 (16)	381

LAKE DATA TO BE USED IN RANKINGS

LAKE CODE	LAKE NAME	MEDIAN TOTAL P	MEDIAN INORG N	500-MEAN SEC	MEAN CHLORA	15-MIN DO	MEDIAN DISS ORTHO P
3901	BEACH CITY RESERVOIR	0.122	1.990	489.000	10.867	11.600	0.015
3902	BUCKEYE LAKE	0.179	0.380	490.000	186.567	9.600	0.020
3905	CHARLES MILL RESERVOIR	0.127	0.465	482.555	67.144	15.000	0.011
3906	DEER CREEK RESERVOIR	0.098	2.980	470.125	9.887	13.900	0.036
3907	DELAWARE RESERVOIR	0.086	2.340	484.111	10.856	14.500	0.024
3908	DILLION RESERVOIR	0.163	1.590	481.250	27.400	14.300	0.037
3912	GRANT LAKE	0.113	0.570	486.333	40.533	12.200	0.019
3914	HOOVER RESERVOIR	0.040	1.640	462.750	13.017	14.800	0.008
3915	INDIAN LAKE	0.120	0.380	485.222	76.855	14.200	0.012
3917	LORAMIE LAKE	0.185	1.380	494.000	104.100	8.200	0.019
3921	MOSQUITO CREEK RESERVOIR	0.058	0.150	465.333	36.267	11.600	0.006
3924	PLEASANT HILL LAKE	0.036	0.455	456.833	22.850	14.700	0.010
3927	LAKE SAINT MARYS	0.148	0.200	484.167	79.150	8.200	0.014
3928	ATWOOD RESERVOIR	0.031	0.205	462.000	16.442	14.700	0.005
3929	BERLIN RESERVOIR	0.042	0.900	465.435	15.496	13.600	0.006
3930	HOLIDAY LAKE	0.125	0.575	465.333	55.350	15.000	0.034
3931	O'SHAUGNESSY RESERVOIR	0.208	3.070	479.333	5.522	14.900	0.159
3932	ROCKY FORK LAKE	0.067	0.790	473.000	38.022	15.000	0.010
3933	SHAWNEE LAKE	0.069	2.380	474.333	39.567	15.000	0.009
3934	TAPPAN LAKE	0.040	0.280	466.111	37.711	15.000	0.007

APPENDIX B

CONVERSIONS FACTORS

CONVERSION FACTORS

Hectares x 2.471 = acres

Kilometers x 0.6214 = miles

Meters x 3.281 = feet

Cubic meters x 8.107×10^{-4} = acre/feet

Square kilometers x 0.3861 = square miles

Cubic meters/sec x 35.315 = cubic feet/sec

Centimeters x 0.3937 = inches

Kilograms x 2.205 = pounds

Kilograms/square kilometer x 5.711 = lbs/square mile

APPENDIX C

TRIBUTARY FLOW DATA

TRIBUTARY FLOW INFORMATION FOR OHIO 1/27/75

LAKE CODE 3929 BERLIN RESERVOIR

TOTAL DRAINAGE AREA OF LAKE(SQ KM) 642.3

TRIBUTARY	SUB-DRAINAGE AREA(SQ KM)	NORMALIZED FLOWS(CMS) JAN	FEB	MAR	APR	MAY	JUN	JUL	AUG	SEP	OCT	NOV	DEC	MEAN
3929A1	642.3	6.66	9.12	9.57	5.92	6.80	6.71	7.36	7.39	5.78	3.74	2.32	4.08	6.21
3929A2	231.0	3.48	4.42	5.64	4.05	2.86	1.39	0.88	0.68	0.31	0.62	0.82	1.93	2.24
3929B1	49.5	0.74	0.95	1.22	0.88	0.65	0.24	0.19	0.09	0.04	0.12	0.15	0.42	0.47
3929C1	15.3	0.23	0.28	0.40	0.31	0.18	0.10	0.06	0.03	0.02	0.03	0.06	0.13	0.15
3929D1	49.2	0.74	0.91	1.22	0.99	0.57	0.31	0.20	0.11	0.08	0.09	0.20	0.42	0.48
3929E1	98.4	1.50	1.78	2.38	1.93	1.13	0.65	0.40	0.24	0.17	0.19	0.42	0.85	0.97
3929F1	16.8	0.26	0.31	0.42	0.34	0.20	0.11	0.07	0.04	0.03	0.03	0.07	0.15	0.17
3929Z7	182.1	2.80	3.26	4.36	3.51	2.07	1.25	0.76	0.45	0.34	0.37	0.79	1.61	1.79

SUMMARY

TOTAL DRAINAGE AREA OF LAKE = 642.3
SUM OF SUB-DRAINAGE AREAS = 642.3

TOTAL FLOW IN = 75.71
TOTAL FLOW OUT = 74.64

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3929A1	5	73	16.25	5	17.70				
	6	73	5.10	3	3.34				
	7	73	5.52	22	5.30				
	8	73	6.63	18	6.99				
	9	73	7.16	29	5.32				
	10	73	2.15	20	1.76				
	11	73	2.52	4	1.76				
	12	73	8.95	2	12.57				
	1	74	12.40	6	16.57				
	2	74	6.88	3	23.05	15	4.73		
	3	74	19.57	3	2.69	16	29.73		
	4	74	13.22	7	29.73				
3929A2	5	73	4.76	5	2.38				
	6	73	2.38	3	1.93				
	7	73	0.96	22	2.92				
	8	73	1.19	18	2.89				
	9	73	0.51	29	1.08				
	10	73	1.19	20	1.02				
	11	73	2.75	4	1.59				
	12	73	4.19	2	2.29				
	1	74	6.12	6	1.73				
	2	74	2.63	3	2.15	15	2.07		
	3	74	9.15	3	6.71	16	10.00		
	4	74	4.39	7	4.16				

TRIBUTARY FLOW INFORMATION FOR OHIO 1/27/75

LAKE CODE 3929 BERLIN RESERVOIR

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
392981	5	73	1.44	5	0.48				
	6	73	0.24	3	0.19				
	7	73	0.19	22	0.18				
	8	73	0.16	18	0.40				
	9	73	0.06	29	0.13				
	10	73	0.14	20	0.12				
	11	73	0.24	4	0.14				
	12	73	0.62	2	0.34				
	1	74	1.13	6	0.34				
	2	74	0.48	3	0.40	15	0.31		
	3	74	1.95	3	1.44	16	2.15		
	4	74	0.74	7	0.51				
3929C1	5	73	0.40	5	0.15				
	6	73	0.09	3	0.08				
	7	73	0.06	22	0.06				
	8	73	0.06	18	0.14				
	9	73	0.04	29	0.03				
	10	73	0.03	20	0.02				
	11	73	0.09	4	0.05				
	12	73	0.19	2	0.10				
	1	74	0.37	6	0.10				
	2	74	0.14	3	0.12	15	0.10		
	3	74	0.62	3	0.45	16	0.65		
	4	74	0.26	7	0.16				
392901	5	73	1.25	5	0.48				
	6	73	0.31	3	0.25				
	7	73	0.20	22	0.19				
	8	73	0.19	18	0.48				
	9	73	0.13	29	0.28				
	10	73	0.10	20	0.08				
	11	73	0.31	4	0.18				
	12	73	0.72	2	0.34				
	1	74	1.13	6	0.34				
	2	74	0.45	3	0.40	15	0.31		
	3	74	1.95	3	1.42	16	2.12		
	4	74	0.82	7	0.51				
3929E1	5	73	2.49	5	0.93				
	6	73	0.65	3	0.54				
	7	73	0.40	22	0.37				
	8	73	0.40	18	0.96				
	9	73	0.27	29	0.0				
	10	73	0.21	20	0.0				
	11	73	0.65	4	0.0				
	12	73	1.22	2	0.0				
	1	74	2.32	6	0.0				
	2	74	0.88	3	0.79	15	0.62		
	3	74	3.79	3	2.85	16	4.25		
	4	74	1.59	7	1.02				

TRIBUTARY FLOW INFORMATION FOR OHIO 1/27/75

LAKE CODE 3929 BERLIN RESERVOIR

MEAN MONTHLY FLOWS AND DAILY FLOWS(CMS)

TRIBUTARY	MONTH	YEAR	MEAN FLOW	DAY	FLOW	DAY	FLOW	DAY	FLOW
3929F1	5	73	0.42	5	0.16				
	6	73	0.10	3	0.08				
	7	73	0.07	22	0.07				
	8	73	0.07	16	0.16				
	9	73	0.04	29	0.09				
	10	73	0.03	20	0.03				
	11	73	0.10	4	0.06				
	12	73	0.22	2	0.12				
	1	74	0.40	6	0.12				
	2	74	0.15	3	0.13	15	0.11		
	3	74	0.68	3	0.48	16	0.74		
	4	74	0.28	7	0.17				
3929Z2	5	73	4.56						
	6	73	1.22						
	7	73	0.74						
	8	73	0.76						
	9	73	0.54						
	10	73	0.40						
	11	73	1.22						
	12	73	2.32						
	1	74	4.36						
	2	74	1.51						
	3	74	6.97						
	4	74	2.92						

APPENDIX D

PHYSICAL and CHEMICAL DATA

STORET RETRIEVAL DATE 73/01/27

392901
41 02 37.0 081 00 16.0
BERLIN RESERVOIR
39133 OHIO

11EPALES
3

2111202
0028 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/04/24	09 25	0000			50	400	8.20	58	0.060	1.100	0.890	0.009
	09 25	0008	13.3	10.4		390	8.20	60	0.070	0.600	0.960	0.006
	09 25	0015				390	8.00	60	0.080	0.600	1.000	0.005
	09 25	0025	11.0	10.0		380	7.80	61	0.070	0.500	1.100	0.004
	09 35	0000	14.0		50	400	8.20					
	09 35	0008				380	8.10					
	09 35	0015	12.4	10.2		385	8.00					
	09 35	0025				380	7.80					
73/07/30	10 25	0000	24.6		36	398	7.80	79	0.090	0.600	0.280	0.003
	10 25	0005	24.4	5.4		396	7.70	79	0.080	0.600	0.260	0.002K
	10 25	0012	24.4	5.5		395	7.70	78	0.100	0.500	0.280	0.002K
73/10/08	17 35	0000	19.7	6.8	37	409	7.60	80	0.040	0.700	0.260	0.006
	17 35	0015	19.0	5.8		404	7.50	83	0.040	0.400	0.260	0.006
	17 35	0025	18.9	5.8		402	7.50	88	0.040	0.400	0.270	0.006

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/04/24	09 25	0000	0.041	13.3
	09 25	0008	0.032	
	09 25	0015	0.034	
	09 25	0025	0.025	
	09 35	0000		13.2
73/07/30	10 25	0000	0.027	5.4
	10 25	0005	0.026	
	10 25	0012	0.028	
73/10/08	17 35	0000	0.040	6.3
	17 35	0015	0.038	
	17 35	0025	0.044	

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/01/27

392902
41 01 09.0 081 00 02.0
BERLIN RESERVOIR
39099 OHIO

11EPALES
3

2111202
0050 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/04/24	10 15	0000	13.7		37	385	8.20	60	0.040	0.800	0.890	0.006
	10 15	0008	13.2	10.8		380	8.20	61	0.050	0.700	0.930	0.005
	10 15	0015	12.7	10.0		380	8.00	28	0.060	0.600	0.940	0.009
	10 15	0020	11.6	9.8		380	7.90	28	0.100	0.600	0.980	0.005
	10 15	0035				380	7.80	27	0.120	0.600	0.980	0.007
	10 15	0046				380	7.70	62	0.170	0.700	1.000	0.009
	10 25	0000			37	385	8.20					
	10 25	0008				380	8.20					
	10 25	0015				380	8.00					
	10 25	0020				380	7.90					
	10 25	0035	10.4	9.1		380	7.80					
	10 25	0046	10.0	8.6		385	7.70					
73/07/30	11 50	0000	24.8		38	404	8.10	76	0.090	0.900	0.240	0.003
	11 50	0005	24.7	7.3		407	7.90	78	0.100	0.800	0.220	0.002
	11 50	0015	24.4	5.8		405	7.70	76	0.130	0.800	0.230	0.002
	11 50	0025	24.2	6.1		407	7.70	77	0.140	0.800	0.220	0.003
73/10/08	17 10	0000	19.7	6.6	30	413	7.70	85	0.040	0.600	0.240	0.006
	17 10	0015	18.7	5.8		421	7.60	87	0.060	0.600	0.260	0.008
	17 10	0027	18.5	4.2		420	7.50	85	0.060	0.700	0.290	0.009
	17 10	0036	18.4	3.8		422	7.50	86	0.100	0.800	0.320	0.010

STORET RETRIEVAL DATE 75/01/27

392902
41 01 09.0 081 00 02.0
BERLIN RESERVOIR
39099 OHIO

11EPALES 21112U2
3 0050 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/04/24	10 15	0000	0.034	14.7
	10 15	0008	0.031	
	10 15	0015	0.026	
	10 15	0020	0.033	
	10 15	0035	0.031	
	10 15	0046	0.032	
	10 25	0000		14.7
73/07/30	11 50	0000	0.027	12.2
	11 50	0005	0.029	
	11 50	0015	0.028	
	11 50	0025	0.033	
73/10/04	17 10	0000	0.041	6.0
	17 10	0015	0.042	
	17 10	0027	0.061	
	17 10	0036	0.102	

STORET RETRIEVAL DATE 75/01/27

392903
41 00 18.0 081 00 10.0
BERLIN RESERVOIR
39133 OHIO

11EPALES
3

2111202
0028 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/04/24	11	10 0000	13.4		40	380		62	0.050	0.600	0.840	0.005
	11	10 0007	13.2	10.4		380		61	0.040	0.700	0.890	0.004
	11	10 0015	12.7	9.7		380		60	0.050	0.600	0.920	0.004
	11	10 0025				360		61	0.100	0.600	0.870	0.005
	11	20 0000			40	375						
	11	20 0007				380						
	11	20 0015				380						
	11	20 0025	10.9	9.1		365						
73/10/08	16	40 0000	18.8	6.4	38	423	7.90	88	0.040	1.000	0.230	0.011
	16	40 0010	18.6	6.0		425	7.70	90	0.060	0.600	0.230	0.005
	16	40 0018	18.5	5.6		433	7.60	91	0.080	0.700	0.200	0.005

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/04/24	11	10 0000	0.027	10.1
	11	10 0007	0.024	
	11	10 0015	0.025	
	11	10 0025	0.027	
	11	20 0000		13.3
73/10/08	16	40 0000	0.063	7.8
	16	40 0010	0.045	
	16	40 0018	0.056	

STORET RETRIEVAL DATE 75/01/27

392904
40 59 45.0 081 00 48.0
BERLIN RESERVOIR
39133 OHIO

HEPALES
J

2111202
0018 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/04/24	13	35 0000	14.5		36	380	8.50	63	0.040	0.900	0.860	0.006
	13	35 0008	13.6	11.8		390	8.30	61	0.040	1.000	0.880	0.006
	13	35 0015	12.9	11.0		390	8.20	61	0.050	0.700	0.890	0.004
	13	45 0000			36	380	8.50	61	0.040	1.000	0.850	0.006
	13	45 0008				385	8.40	60	0.040	0.900	0.870	0.005
	13	45 0015				390	8.20	60	0.050	0.700	0.900	0.005
73/10/08	16	20 0000	19.3	6.8	36	427	8.20	90	0.050	1.100	0.220	0.007
	16	20 0008	18.7	5.8		426	7.90	88	0.040	0.800	0.270	0.007

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/04/24	13	35 0000	0.043	22.8
	13	35 0008	0.051	
	13	35 0015	0.041	
	13	45 0000	0.049	22.6
	13	45 0008	0.057	
	13	45 0015	0.042	
73/10/08	16	20 0000	0.055	16.1
	16	20 0008	0.048	

STORET RETRIEVAL DATE 75/01/27

342905
41 00 15.0 081 03 55.0
BERLIN RESERVOIR
39133 OHIO

11EPALES 2111202
3 0014 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/04/24	16	10 0000	16.1		35	395	8.10	58	0.030	0.800	0.610	0.003
	16	10 0007	14.2	9.5		395	7.70	65	0.050	0.600	0.820	0.009
	16	10 0010	12.9	8.9		415	7.80	60	0.090	0.600	0.820	0.008
	16	20 0000			35	395	8.00	56	0.040	0.800	0.590	0.005
	16	20 0007				400	7.70	65	0.060	0.500	0.820	0.010
	16	20 0010				410	7.70	61	0.090	0.500	0.820	0.010
73/07/30	11	25 0000	24.7		36	420	7.80	84	0.140	0.800	0.200	0.009
	11	25 0005	24.7	7.0		420	7.70	84	0.130	1.000	0.190	0.008
	11	25 0015	24.2	4.7		419	7.20	80	0.220	0.900	0.190	0.005
	11	25 0029	23.6	1.4		430	6.80	86	0.420	1.100	0.140	0.007
73/10/08	16	10 0000	19.5	9.8	20	574	8.20	113	0.280	2.300	0.280	0.010

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/04/24	16	10 0000	0.031	14.3
	16	10 0007	0.051	
	16	10 0010	0.046	
	16	20 0000	0.042	13.2
	16	20 0007	0.053	
	16	20 0010	0.051	
73/07/30	11	25 0000	0.044	12.7
	11	25 0005	0.044	
	11	25 0015	0.033	
	11	25 0029	0.042	
73/10/08	16	10 0000	0.126	52.5

STORET RETRIEVAL DATE 75/01/27

392906
40 59 00.0 081 05 41.0
BERLIN RESERVOIR
39151 OHIO

HEPALES 2111202
3 0010 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/04/24	14	35 0000	16.5		24	400	7.90	74	0.110	1.000	0.930	0.049
	14	35 0005	16.1	9.0		400	7.70	74	0.100	0.900	0.920	0.045
	14	35 0008	15.3	8.0		401	7.70	74	0.160	0.700	0.930	0.050
	14	45 0000			24	400	7.80	73	0.110	1.200	0.930	0.047
	14	45 0005				400	7.80	74	0.110	0.900	0.920	0.045
	14	45 0008				400	7.70	74	0.150	0.800	0.930	0.047
73/07/30	10	55 0000	24.5		20	520	9.30	95	0.100	0.800	0.290	0.002
	10	55 0005	24.1	5.6		519	7.70	118	0.270	1.300	0.650	0.022
	10	55 0010	24.0	3.8		534	7.40	120	0.600	1.600	0.890	0.034

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/04/24	14	35 0000	0.121	17.0
	14	35 0005	0.110	
	14	35 0008	0.117	
	14	45 0000	0.097	14.9
	14	45 0005	0.101	
	14	45 0008	0.121	
73/07/30	10	55 0000	0.036	15.7
	10	55 0005	0.161	
	10	55 0010	0.221	

STORET RETRIEVAL DATE 75/01/27

392907
40 58 23.0 081 06 17.0
BERLIN RESERVOIR
39151 OHIO

11EPALES
3

2111202
0008 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00010 WATER TEMP CENT	00300 DO MG/L	00077 TRANSP SECCHI INCHES	00094 CNDUCTVY FIELD MICROMHO	00400 PH SU	00410 T ALK CACO3 MG/L	00610 NH3-N TOTAL MG/L	00625 TOT KJEL N MG/L	00630 NO2&NO3 N-TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P
73/04/24	15 00	0000	17.2		30	405	7.60	77	0.120	1.000	0.860	0.060
	15 00	0005	16.0	6.4		440	7.10	82	0.220	0.900	0.880	0.070
	15 10	0000			30	410	7.50	76	0.140	1.000	0.870	0.058
	15 10	0005				440	7.20	81	0.220	1.000	0.870	0.065

33

DATE FROM TO	TIME OF DAY	DEPTH FEET	00665 PHOS-TOT MG/L P	32217 CHLRPHYL A UG/L
73/04/24	15 00	0000	0.238	22.0
	15 00	0005	0.152	
	15 10	0000	0.136	21.6
	15 10	0005	0.181	

APPENDIX E

TRIBUTARY and WASTEWATER TREATMENT PLANT DATA

STORET RETRIEVAL DATE 75/02/03

3929A1
41 03 31.0 080 59 12.0
MAHONING RIVER
39019 7.5 LK MILTON
O/BERLIN RESERVOIR
2NDRY RD BRDG AT SHILLINGS MILL
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/05	13 55		0.860	2.200	0.066	0.005K	0.045
73/06/03	09 45		0.890	1.100	0.245	0.005K	0.025
73/07/22	10 15		0.280	2.730	0.720	0.022	0.160
73/08/18	09 10		0.210	1.760	0.480	0.030	0.105
73/09/29	10 00		0.340	1.050	0.200	0.015	0.055
73/10/20	11 10		0.336	1.200	0.050	0.009	0.045
73/11/04	10 30		0.420	0.600	0.012	0.005K	0.030
73/12/02	10 30		0.520	0.500	0.052	0.020	0.035
74/01/06	14 00		1.180	0.800	0.200	0.032	0.070
74/02/03	13 55		1.510	1.000	0.220	0.040	0.070
74/02/15	12 00		1.520	0.900	0.220	0.040	0.080
74/03/03	11 10		1.600	1.000	0.120	0.020	0.087
74/03/16	11 40		1.440	0.900	0.095	0.020	0.065
74/04/07	11 05		1.200	0.700	0.100	0.020	0.020

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/02/03

3929A2
40 55 59.0 081 05 44.0
MAHONING RIVER
39 7.5 ALLIANCE
I/BERLIN RESERVOIR
WEBB RD BRDG N EDGE OF ALLIANCE
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/05	15 35		0.880	1.100	0.084	0.052	0.100
73/06/03	11 30		0.780	1.600	0.100	0.049	0.135
73/07/22	11 30		3.900	2.600	0.240	0.078	0.240
73/08/18	10 45		0.710	1.500	0.210	0.086	0.230
73/09/29	11 10		0.530	1.800	0.154	0.138	0.330
73/10/20	12 25		0.430	1.200	0.054	0.210	0.300
73/11/04	11 50		1.260	1.100	0.080	0.060	0.125
73/12/02	12 15		1.900	1.600	0.148	0.060	0.125
74/01/06	15 20		1.760	0.600	0.168	0.048	0.123
74/02/03	14 50		1.760	0.600	0.115	0.050	0.135
74/02/15	13 45		1.400	0.900	0.190	0.090	0.170
74/03/03	12 25		2.000	0.700	0.065	0.035	0.160
74/03/16	13 10		1.430	1.900	0.165	0.075	0.350
74/04/07	10 05		1.060	0.800	0.055	0.025	0.065

STORET RETRIEVAL DATE 75/02/03

342981
41 00 00.0 080 58 10.0
MILL CREEK
39 7.5 DAMASCUS
T/BERLIN RESERVOIR
LEFFINGWELL RD BRDG 1 MI E OF CHRISTYTOW
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/05	16 20		0.240	1.260	0.031	0.008	0.025
73/06/03	11 55		0.069	4.500	0.014	0.006	0.050
73/07/22	12 02		5.500	2.450	0.139	0.039	0.110
73/08/18	11 10		0.660	1.760	0.097	0.035	0.080
73/09/29	11 45		0.072	1.150	0.056	0.014	0.070
73/10/20	12 50		0.013	1.100	0.036	0.022	0.022
73/11/04	12 10		1.040	1.200	0.028	0.020	0.040
73/12/02	12 45		2.000	0.700	0.032	0.024	0.040
74/01/06	15 45		1.500	0.400	0.056	0.008	0.025
74/02/03	15 15		1.260	0.700	0.035	0.015	0.015
74/02/15	14 10		0.910	0.800	0.065	0.015	0.035
74/03/03	12 55		2.640	0.800	0.037	0.010	0.075
74/03/16	13 35		1.400	1.300	0.105	0.045	0.170
74/04/07	09 40		0.288	0.900	0.040	0.010	0.035

STORET RETRIEVAL DATE 75/02/03

3329C1
40 58 22.0 081 00 45.0
ISLAND CREEK
39 7.5 ALLIANCE
T/BERLIN RESERVOIR
2NDRY RD BRDG 0.7 MI S OF NORTH BENTON
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/05	16 05		0.470	1.540	0.042	0.033	0.075
73/06/03	11 45		1.860	1.300	0.034	0.012	0.115
73/07/22	11 45		7.700	3.600	0.230	0.075	0.155
73/08/18	10 55		1.860	2.100	0.100	0.150	0.290
73/09/29	11 30		0.410	3.990	1.100	0.028	0.300
73/10/20	12 45		0.025	1.450	0.126	0.060	0.145
73/11/04	12 00		1.920	1.450	0.044	0.100	0.185
73/12/02	12 30		1.760	0.750	0.072	0.040	0.076
74/01/06	15 40		1.300	0.500	0.100	0.028	0.085
74/02/15	14 00		0.820	1.700	0.320	0.100	0.380
74/03/03	12 45		2.200	1.000	0.050	0.025	0.110
74/03/16	13 25		1.040	2.300	0.145	0.080	0.270
74/04/07	09 50		0.312	1.300	0.075	0.025	0.040

STORET RETRIEVAL DATE 75/02/03

392901
40 56 03.0 081 08 20.0
BEECH CREEK
39 7.5 LIMAVILLE
T/BERLIN RESERVOIR
AERI AVE BRDG .6 MI S OF ST RT 619
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/09	15 20		0.690	1.260	0.028	0.042	0.075
73/06/03	10 45		1.060	1.100	0.039	0.017	0.050
73/07/22	11 07		6.100	3.150	0.126	0.060	0.165
73/08/18	10 30		0.370	0.780	0.029	0.046	0.080
73/09/29	10 50		0.310	1.470	0.147	0.105	0.430
73/10/20	12 15		0.170	1.200	0.038	0.060	0.070
73/11/04	11 40		1.800	1.250	0.048	0.052	0.095
73/12/02	11 30		1.800	0.700	0.060	0.048	0.085
74/01/06	15 15		1.760	0.500	0.115	0.036	0.070
74/02/03	14 20		1.700	0.500	0.075	0.030	0.060
74/02/15	13 05		1.400	0.800	0.145	0.035	0.080
74/03/03	12 15		2.300	0.900	0.055	0.030	0.150
74/03/16	12 40		1.400	1.700	0.215	0.080	0.150
74/04/07	10 15		0.880	1.100	0.035	0.027	0.040

STORET RETRIEVAL DATE 75/02/03

3929E1
40 58 10.0 081 07 15.0
DEEP CREEK RES SPILLWAY
39 7.5 ALLIANCE
T/BERLIN RESERVOIR
DEEP CREEK RESERVOIR SPILLWAY
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/05	15 00		0.500	1.760	0.074	0.006	0.040
73/06/03	10 25		0.420	1.760	0.006	0.005K	0.035
73/08/18	10 10		0.160	1.000	0.105	0.016	0.040
74/02/15	12 45		0.940	0.800	0.015	0.007	0.055
74/03/03	12 00		0.890	0.800	0.025	0.005K	0.060
74/03/16	12 20		0.720	1.100	0.075	0.010	0.055
74/04/07	10 35		0.870	0.700	0.055	0.010	0.010

K VALUE KNOWN TO BE
LESS THAN INDICATED

STORET RETRIEVAL DATE 75/02/03

39291
41 01 30.0 081 04 47.0
WILLOW CREEK
39 7.5 DEERFIELD
T/BERLIN RESERVOIR
NOTMAN RD BRDG N OF US 224
11EPALES 2111204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P
73/05/05	14 20		0.100	1.430	0.048	0.005K	0.030
73/06/03	10 10		0.015	1.050	0.010	0.007	0.050
73/07/22	10 30		3.500	2.800	0.231	0.015	0.065
73/08/14	09 50		0.190	0.800	0.046	0.008	0.025
73/09/29	10 20		0.082	1.470	0.077	0.005K	0.035
73/10/20	11 45		0.011	0.800	0.046	0.007	0.045
73/11/04	11 10		0.520	1.200	0.044	0.012	0.045
73/12/02	10 46		0.380	0.600	0.036	0.016	0.030
74/01/06	14 30		0.420	0.700	0.100	0.008	0.015
74/02/03	14 10		0.240	0.300	0.065	0.005K	0.005K
74/02/15	12 30		0.336	0.800	0.155	0.005K	0.085
74/03/03	11 25		1.010	0.800	0.035	0.005K	0.065
74/03/16	12 10		0.430	0.800	0.060	0.010	0.100
74/04/07	10 50		0.072	0.400	0.045	0.005K	0.025

LESS THAN INDICATED
K VALUE KNOWN TO BE

STORET RETRIEVAL DATE 75/02/03

3929AA TF3929AA P030000*
40 57 20.0 081 07 05.0
ALLIANCE
39019 7.5 ALLIANCE
T/BERLIN RESERVOIR
MAHONING RIVER
11EPALES 2141204
4 0000 FEET DEPTH

DATE FROM TO	TIME OF DAY	DEPTH FEET	00630 NO2&NO3 N-TOTAL MG/L	00625 TOT KJEL N MG/L	00610 NH3-N TOTAL MG/L	00671 PHOS-DIS ORTHO MG/L P	00665 PHOS-TOT MG/L P	50051 FLOW RATE INST MGD	50053 CONDUIT FLOW-MGD MONTHLY
73/08/14	00 00								
CP(T)-			0.040	15.000	0.740	4.300	10.500	2.400	2.600
73/08/14	24 00								
73/09/14	07 30		1.920	14.700	2.220	7.240	8.450	2.400	3.000
73/10/14	07 30		4.900	9.400	0.220	5.200	5.600	2.500	
73/11/14	06 00		4.400	21.000	4.800	6.100	7.700	2.640	2.800
73/12/14			4.400	11.500	0.052	3.590	5.500	3.400	2.900
74/01/14			2.000	17.000	3.680	5.800	8.500	3.400	3.300
74/02/14	00 00								
CP(T)-			5.100	10.000	1.400	4.000	5.000	2.700	3.400
74/02/14	02 00								
74/03/14	00 00								
CP(T)-			0.040	11.000			6.300	3.400	3.900
74/03/14	24 00								
74/04/14			5.100	5.400	0.050	3.700	5.000	3.900	3.500
74/05/14			2.050	9.350	0.210	3.600	5.500	3.000	3.200
74/06/14	06 00								
CP(T)-			0.120	18.000	4.000	8.500	9.100	2.200	3.500
74/06/15	06 00								
74/07/20	06 00								
CP(T)-			0.080	15.000	7.600	6.200	7.900	2.500	2.700
74/07/21	06 00								
74/08/13	06 00								
CP(T)-			0.080	19.000	5.700	4.800	6.400	3.100	2.900
74/08/14	06 00								